

THORACIC MODIFICATIONS ACCOMPANYING THE
DEVELOPMENT OF SUBAPTERY AND APTERY
IN THE GENUS *MONOMORIUM*¹

BY GEORGE S. TULLOCH.

The occasional appearance of forms intermediate between the alate and the apterous castes of the Formicidæ offers some ontological evidence of early stages in the origin of castes and has an important bearing on the question of development of organic forms through continuous or saltatory variation. The differentiation into castes is a condition which has existed for a long period of time since it is clearly shown in the many beautifully preserved ants of the Baltic amber from the Lower Oligocene Tertiary.

In several genera of ants it is possible to trace all the transitional stages in the thoracic structure from that of the winged female to the wingless worker, except that the wings show no transitions, being perfectly developed in the typical female and entirely lacking in all the other forms of the series. In two genera gradational changes in the wing structure have been figured, one in the genus *Monomorium* (Wheeler, 17) and the other in the genus *Pogonomyrmex* (Tulloch, 30). The series of *P. californicus* which was given to the writer by Professor Harlow Shapley of the Harvard College Observatory exhibited various transitional stages of the wing from the completely venated type to a veinless wing sac. However, the appearance of these forms was considered to be pathological (since they only occurred in one colony) and, therefore, are perhaps not as instructive as the case noted by Dr. Wheeler in the genus *Monomorium*. Here it was discovered that at least two species exhibited a normal and unsuspected condition of subaptery in the female.

¹ Contribution from the Entomological Laboratory of Harvard University, No. 336.

Before proceeding to the description of this condition of subaptery, it should be noted that an extremely unusual condition of aptery has long been recognized in *Monomorium*. In *Monomorium floricola*, *M. carbonarium* subsp. *ebeninum* and *M. minutum* subsp. *ergatogyna* Dr. Wheeler (1905) observed that the females had a thoracic structure typical of winged forms, yet they showed no indication of ever having borne wings. Thus we have a case of aptery unaccompanied by the usual fusion of sclerites and by huge diminution in size of the thorax. Forel describes *M. andrei* of Oran as having both winged and ergatoid females as well as the Indian *M. shurri* and *M. dichroum*, but as he fails to explain the thoracic structure of the ergatoid and the winged female, it is impossible to judge whether the apterous condition here is similar to the case cited by Dr. Wheeler.

In two Australian species, *M. rothsteini* and *M. (Notomyrmex) subapterum*, the males show no differences in the size and development of the wings, which in both species are large and of the usual structure, but the females exhibit differences in the size of the thorax and wings. The wing of *rothsteini* measures 6.8-7 mm., while that of *subapterum* is only 3 mm., and its thorax is also much reduced in size. A somewhat similar case was found in the female of the related species *M. (Notomyrmex) rubriceps*. In a specimen of an incompletely deälated female the size of the remaining hind wing indicated that all the wings were very much reduced previous to deäilation, and probably represented a more advanced condition of subaptery than the female of *subapterum*. It should be noted that in the case of *subapterum* several specimens of the female were available for study, each exhibiting the subapterous condition of the wing. In the case of *rubriceps* only a single specimen of the female illustrates the subapterous condition, while in five other specimens from the same nest all the intermediate stages between the subapterous and the apterous condition are represented. In the case of *subapterum* the condition of subaptery is evidently normal, while in *rubriceps* it is, perhaps, abnormal. However, whatever the case may be, the female of *rubriceps* repre-

sents a new condition of subaptery which had been hitherto unknown until described by Dr. Wheeler.

The specimens of *M. rubriceps*, six in number, were found to contain an interesting series of intermediate forms between the subapterous condition represented by

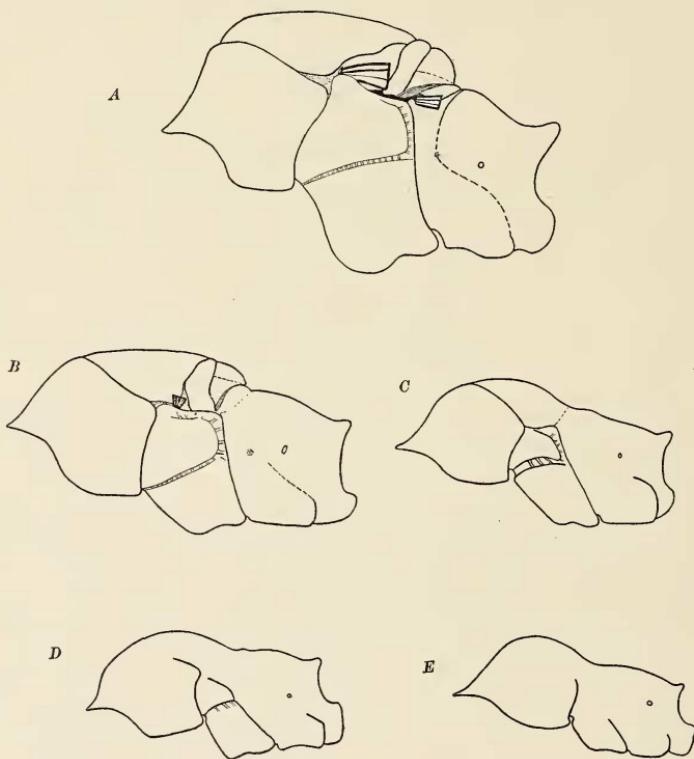


Fig. 1. Thoracic modifications in *Monomorium*.

the female mentioned above and the apterous condition exhibited by the worker. Dr. Wheeler first noted this series and figured the modifications existing in the notal regions of the thorax. Since the pleural regions exhibit various equally interesting morphological modifications from the winged to the apterous condition, and since they may represent phylogenetic stages in the origin of castes,

the following description is offered. The specimens examined are all from the collection of Dr. Wheeler, through whose kindness the writer is enabled to describe them.

The subapterous female of this particular species measures 6.5 mm., has well-developed ocelli, and its thorax (Fig. A), although somewhat reduced, is of the same general composition as its close relative, *M. subapterum*. The stumps of wings are present except on the hind right side, where the entire wing is retained. It is much reduced in size and may be considered as vestigial. The other wings have been lost by déiliation. The structure of the pleural region of the thorax is not unlike that of other Myrmicinæ, and since it is not the purpose of this paper to discuss the morphology of these forms, but rather to indicate the annectant stages between the alate and the apterous castes, a discussion of the different sclerites is omitted. The second stage (Fig. B) is one in which the hind wings have entirely disappeared, yet the stumps of the fore wings are present. The transition to this stage has been accompanied by a reduction in size of the thorax and by the fusion of the pleuron and notum in the regions formerly occupied by the hind wings. A further step in the series (Fig. C), indicated that the wings have totally disappeared, and the thorax has become greatly reduced in size. Fig. D represents another stage illustrating a simplification of structure and a reduction in size. Fig. E represents the true worker and is characterized by the presence of an enlarged pronotum, which appears to be a fairly constant character of the worker caste among most genera of Myrmicinæ.

The evidence derived from the series of *Pogonomyrmex* and this series of *Monomorium* may have an important bearing on the question of the production of organic forms through continuous or saltatory variation. The gradation of the intermediate forms is so continuous that one is almost forced to accept the explanation of the production of organic forms through continuous variation as the more logical of the two. The appearance of intermediate forms would seem to suggest at once that the origin of castes could not have come about as a saltatory variation or mutation. It is very possible that the explanation involving continuous variation may be incorrect, and one must turn to other

hypotheses to answer this question. When one considers the influence of nutritional factors upon the production of abnormal forms (especially among the arthropods), it is quite possible that the suggestion made by LaMeere (1909) considering nutritional factors as influencing the origin of castes among the ants may be of greater significance than has been hitherto suspected.

Literature Cited

- Forel, A.* 1894. Les Formicides de la Province d'Oran. Bull. Soc. Vaud. Sc. Nat. 30:1-45.
1902. *Myrmicinæ* nouveaux de l'Inde et de Ceylon. Rev. Suisse Zoöl., T. X., 1902, p. 165-249.
- LaMeere, A.* 1909. L'Origine des Societies d'Insectes. Ann. Soc. Ent. Belg. 53, pp. 507-515.
- Tulloch, G. S.* 1930. An unusual nest of *Pogonomyrmex*. *Psyche*, Vol. XXXVII, No. 1.
- Wheeler, W. M.* 1905. The Ants of the Bahamas. Bull. Amer. Mus. of Nat. Hist. Vol. XXI.
1917. The Phylogenetic Development of Subapterous and Apterous Castes in the Formicidæ. Proc. Nat. Acad. of Sci., Vol. 3, pp. 109-117.